REMARKS

Applicants thank the Examiner for the thorough consideration given the present application. Claims 1-9 are pending in the present application. By this response, claims 1, 2, and 4 are amended, and claims 7-9 are added.

35 U.S.C. § 103(a) Rejection – Fujinami and Yokota

Claims 1-3 and 5-6 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Patent Publication 2004085013 by Fujinami et al. (hereafter "Fujinami") in view of Japanese Patent Publication 072655649 by Yokota et al. (hereafter "Yokota"). Insofar as it pertains to the presently pending claims, this rejection is respectfully traversed.

Claim 1

Independent claim 1 pertains to a heat exchanger comprising a fin set, a heat transfer tube penetrating the fin set, a "a metallic framework arranged to surround end faces of the fin set in the arrangement direction of the fins and end faces of the fin set in the lengthwise direction of the fins," and an adsorbent coating for the framework, fins, and tube.

With respect to independent claim 1, Fujinami teaches a heat exchanger having a heat transfer pipe and plate-like fins that are oriented orthogonally to the heat transfer pipe. Figure 2 shows what may be a framework box that presumably surrounds the heat exchange pipe and fins. The "framework box" of Fujinami, however, is disclosed as consisting of tube plates. (Para [0017] of the attached machine translation of Fujinami). A tube plate is a term of art that refers to a plate in a heat exchanger to which a number of tubes are joined by welding or an expander. Tube plates refer to structure members arranged parallel to the fins only on both sides of a fin set. A tube plate in a heat exchanger does not describe a member arranged along the "end faces of the fin set in the lengthwise direction of the fins" as required by independent claim 1.

Fujiami's specification does not suggest or directly teach that there are more than two tube plates in Figure 2, or that the tube plates are arranged all around the periphery of the heat exchanger. Figure 2 fails to clearly indicate any parts corresponding to tube plates on the right or left side of the heat exchanger. Fujiami also fails to indicate whether the tube plates are metallic.

Applicants respectfully submit that, based on Fujinami's disclosure and an understanding of the art, the tube plates in Fujinami should be regarded as being arranged only on the front and back of the fin set, as in conventional heat exchangers. The unmarked structure on the side of the heat exchanger shown in Figure 2 is not indicative of a tube plate and the specification does not otherwise indicate that there is any kind of metallic framework "arranged to surround end faces of the fin set in the arrangement direction of the fins and end faces of the fin set in the lengthwise direction of the fins" as required by independent claim 1.

The Office Action relies on Yokota to teach coating adsorbing material on an entire surface of a heat exchanger. Yokota is not relied upon, nor can it properly be relied upon, to remedy the deficiencies of Fujinami with respect to independent claim 1. Applicants therefore submit that neither Fujinami nor Yokota, taken either alone or in combination (assuming the references may be combined, which Applicants do not admit) teach or suggest a metallic framework "arranged to surround end faces of the fin set in the arrangement direction of the fins and end faces of the fin set in the lengthwise direction of the fins" as required by independent claim 1.

Claims 2, 3, 5-6

Applicants respectfully submit that claims 2, 3, and 5-6 are allowable at least by virtue of their dependency from independent claim 1. Accordingly, reconsideration and withdrawal of this rejection is respectfully requested.

35 U.S.C. § 103(a) Rejection – Fujinami and VonDobein

Claims 1-3 and 5-6 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Fujinami in view of German Patent Publication 32226502A by VonDobein (hereafter "VonDobein"). Insofar as it pertains to the presently pending claims, this rejection is respectfully traversed.

With respect to independent claim 1, Applicants respectfully submit that Fujinami is deficient in its teachings for the reasons set forth above in the traversal of the Fujinami/Yokota §103 rejection.

The Office Action relies on VonDobein to teach coating adsorbing material on an entire surface of a heat exchanger. VonDobein is not relied upon, nor can it properly be relied upon, to remedy the deficiencies of Fujinami with respect to independent claim 1. Applicants therefore submit that neither Fujinami nor VonDobein, taken either alone or in combination (assuming the references may be combined, which Applicants do not admit) teach or suggest a metallic framework "arranged to surround end faces of the fin set in the arrangement direction of the fins and end faces of the fin set in the lengthwise direction of the fins" as required by independent claim 1.

Claims 2, 3, 5-6

Applicants respectfully submit that claims 2, 3, and 5-6 are allowable at least by virtue of their dependency from independent claim 1. Accordingly, reconsideration and withdrawal of this rejection is respectfully requested.

35 U.S.C. § 103 Rejection – Fujinami and Yokota or VonDobein

Claim 4 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Fujinami in view of either Yokota or VonDobein. Insofar as it pertains to the presently pending claims, this rejection is respectfully traversed.

Applicants respectfully submit that claim 4 is allowable at least by virtue of its dependency from independent claim 1. Accordingly, reconsideration and withdrawal of this rejection is respectfully requested.

New Claims

Applicants respectfully submit that new claims 7-9 are allowable at least for the same reasons as set forth above in connection with independent claim 1 and all claims depending therefrom.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone D. Richard Anderson, Registration No. 40,439, at (703) 205-8000, in the Washington, D.C. area.

Prompt and favorable consideration of this Amendment is respectfully requested.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Dated: March 6, 2008

Respectfully submitted,

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Enclosures:
Machine translation of Japanese Patent Publication 2004-085013

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
The invention in this application relates to a heat exchanger.
[0002]
[Description of the Prior Art]
There are some which were constituted by the tabular fin of a large number generally fitted in by a crossed state to the periphery of a heat exchanger tube and this heat exchanger tube as a heat exchanger used for an exhaust-heat-recovery heat exchanger etc. in an absorption type refrigerator (for example, refer to JP,7-19647,A).
[0003]
[Problem(s) to be Solved by the Invention]
However, when it is a heat exchanger of the above-mentioned well-known example, it has various faults in utilization.
[0004]
For example, by increasing a solution circulating load in the case of the exhaust-heat-recovery heat exchanger used in the absorption type refrigerator constituted so that an exhaust-heat-recovery heat exchanger may be made to circulate through the solution from a gas liquid separation device with a solution pump, Solution temperature in the outlet side of an exhaust-heat-recovery heat exchanger can be made low, and exhaust heat recovery quantity is to be increased from a point of temperature efficiency. Therefore, many solution circulating loads of an exhaust-heat-recovery heat exchanger will be good, so that there are.
[0005]
In however, the case of the air cooled heat exchanger used in the compression cycle type freezer known well from the former. Since the tube diameter is too thin when the heat exchanger tube of 6 mm - about 12 mm of tube diameters and the fin of about 0.1 mm of board thickness are usually used and use the heat exchanger tube of such a tube diameter for an exhaust-heat-recovery heat exchanger, a pressure loss becomes large too much and will cause degradation.
[0006]
Since it is above, in an exhaust-heat-recovery heat exchanger, it is difficult to adopt the same heat exchanger tube and fin as the air cooled heat exchanger which needs to use a heat exchanger tube with a big tube diameter, and is used for the compression cycle type freezer.
[0007]
When manufacturing the heat exchanger of the above structures, the heat exchanger tube and the tabular fin are to be combined in one by expanding a heat exchanger tube, after fitting a tabular fin in a heat exchanger tube, but. When the tube diameter of a heat exchanger tube becomes large, since fin intensity is insufficient, in the tabular fin of 0.1 mm of board thickness, there is a possibility that a fin may bend at the time of expansion. In order to prevent such a deflection, it is necessary to lower an expansion rate but [then], and poor adhesion of a heat exchanger tube and a tabular fin arises, and it is connected with performance degradation. On the contrary, if an expansion rate tends to be raised and it is going to secure the degree of adhesion of a heat exchanger tube and a tabular fin, the fault of a tabular fin changing and causing the increase in air lateral-pressure loss will arise. Air lateral-pressure loss not only increases, but a cost hike will be caused when board thickness of a tabular fin is thickened too much. Since this kind of heat exchanger is made into about [breadth 0.6m-1.0m] length, the length of a tabular fin becomes long equally and the tube diameter of the heat exchanger tube is also large, from the place where the resistance at the time of fitting a tabular fin in a heat exchanger tube also becomes large, the work which fits a tabular fin in a heat exchanger tube does dramatically — ******

— flume ******** is also produced.

[0008]

The invention in this application was made in view of the above-mentioned point, and an object of the invention in this application is to realize combination of the optimal heat exchanger tube and fin in putting a heat exchanger in practical use, to have and to aim at improved efficiency and improvement in assembly-operation nature.

[0009]

[Means for Solving the Problem]

the tabular fins 12 and 12 of a large number fitted in according to a crossed state as the 1st means for solving an aforementioned problem in the invention in this application to a periphery of the heat exchanger tube 11 and this heat exchanger tube 11 — in a heat exchanger which consists of ... While setting a tube diameter of said heat exchanger tube 11 as the range of 18 mm – 23 mm, board thickness of each of said tabular fin 12 is set as the range of 0.15 mm – 0.20 mm.

[0010]

by having constituted as mentioned above, each tabular fin 12 will have sufficient intensity — the heat exchanger tube 11 — the tabular fins 12 and 12 — the time of expansion working at the time of attaching .. the tabular fins 12 and 12 — it is lost that .. bends. As a result, since expansion working can be performed at sufficient expansion rate, they are the heat exchanger tube 11 and the tabular fins 12 and 12.. Adhesion can be secured and heat exchanging performance improves.

[0011]

Incidentally, when change of air side heat transfer coefficient R-a_0 by change of the board thickness tf of the tabular fin 12 was investigated, as shown in drawing 6, in the range of board thickness tf=0.15mm-0.2mm of the tabular fin 12, it turned out by same draft-resistance deltaP that the maximum is shown. That is, in same draft-resistance deltaP, best performance can be obtained in the range of board thickness tf=0.15mm-0.2mm of the tabular fin 12. Board thickness tf of the tabular fin 12 = being referred to as 0.18 mm is desirable from improved efficiency.

[0012]

In a heat exchanger further provided with the 1st means of the above as the 2nd means for solving an aforementioned problem in the invention in this application, Said tabular fins 12 and 12 .. When the fin pitch Pf can also be set as the range of 1.6 mm – 2.0 mm and is constituted such, an increase in ventilation power can be suppressed to the minimum. When referred to as fin pitch Pf<1.6mm, if [a draft resistance will become large too much, and fan power will increase, and] fin pitch Pf>2.0mm, the number of the tabular fins 12 will become fewer too much, and heat exchange actions will become insufficient.

[0013]

In a heat exchanger further provided with the 1st or 2nd means of the above as the 3rd means for solving an aforementioned problem in the invention in this application, much louver shape cuts on said each tabular fin 12 — the pieces 16 and 16 of a lifting — cutting, when .. can also be formed and being constituted such — the pieces 16 and 16 of a lifting, while heat transfer performance improves by promotion of boundary layer destruction by .., Fin intensity increases and they are the tabular fins 12 and 12 to the heat exchanger tube 11.. Fit-in workability also improves.

[0014]

[Embodiment of the Invention]

Hereafter, with reference to an attached drawing, the suitable embodiment of the invention in this application is described.

[0015]

The heat exchanger concerning this embodiment is used in the exhaust-heat-recovery regenerator in an absorption type refrigerator.

[0016]

Said exhaust-heat-recovery regenerator consists of the gas liquid separation device 1 and the heat exchanger A for exhaust heat recovery, as shown in drawing 1, Rare solution La supplied in the gas liquid separation device 1 is sent into the heat exchanger A by solution pump LP gas, It is to heat said rare solution La, to reflux this rare solution La to said gas liquid separation device 1, and to separate into the concentrated solution Lm and the refrigerant vapor R in this gas liquid separation device 1 by carrying out heat exchange to exhaust gas G in this heat exchanger A. The numerals 2 are eliminators.

[0017]

many heat exchanger tubes 11 and 11 with which rare solution La flows as the above-mentioned heat exchanger

A is shown in drawing 2 .. and these heat exchanger tubes 11 and 11 .. the tabular fins 12 and 12 of a large number fitted in by a crossed state to a periphery — it consists of .. The numerals 3 are tube plates.

[0018]

As said each tabular fin 12 is shown in drawing 3 and drawing 4, the fin substrate 12a is used as the waffle fin made into the waveform in the circulation direction of exhaust gas G, and the fin collar 15 is formed in the portion in which the heat exchanger tube 11 is fitted at one. moreover — much louver shape cuts on each tabular fin 12 — the pieces 16 and 16 of a lifting .. is formed. When the tabular fin 12 is used as a waffle fin, improvement in heat transfer performance can be aimed at, but it is good also considering the fin substrate 12a of the tabular fin 12 as flat plate shape.

[0019]

the heat exchanger A concerning this embodiment — The heat exchanger tubes 11 and 11 .. the fins 12 and 12 .. the fin collars 15 and 15 — the heat exchanger tubes 11 and 11 after fitting in .. it is to be assembled by carrying out expansion working of ..

[0020]

said pieces 16 and 16 of an end lifting .. is formed in the upper and lower sides of the tabular fin 12 as follows. That is, as shown in drawing 5, the cuts 17 and 17 of the couple of the predetermined length which intersects perpendicularly with the air blasting W are put into the fin substrate 12a of the tabular fin 12, in these cuts 17 and 17, up, a couple cuts one side by causing another side caudad, and the pieces 16 and 16 of a lifting are formed [one side]. Although it, of course, has the operation which promotes boundary layer destruction, since the base 16a and the rising portions 16b and 16b are connected with the fin substrate 12a, this piece 16 of an end lifting acts also as a reinforcing rib which raises fin intensity. If it does in this way, while it will cut and heat transfer performance will improve by promotion of the boundary layer destruction by the piece 16 of a lifting, fin intensity increases and the fit-in workability of the tabular fin 12 to the heat exchanger tube 11 also improves. Although the slit fin type of a section U shape cuts, louver shape cuts also with the piece of a lifting and a heat transfer performance improved effect equivalent to the piece of a lifting is acquired, louver shape cuts from a strong point and the piece of a lifting is more preferred.

[0021]

Said each heat exchanger tube 11 consists of thermal conductors (for example, copper), and is set as 19.1 mm desirably [the tube diameter phi / setting it as the range of 18 mm - 23 mm], and most desirably. On the other hand, said each tabular fin 12 consists of thermal conductors (for example, aluminum or an aluminum alloy), and is set as 0.18 mm desirably [the board thickness tf / setting it as the range of 0.15 mm - 0.20 mm], and most desirably. Tabular fins 12 and 12 .. The fin pitch Pf is set as 1.8 mm desirably [setting it as the range of 1.6 mm - 2.0 mm], and most desirably.

[0022]

by having constituted as mentioned above, the tabular fin 12 will have sufficient intensity — The heat exchanger tubes 11 and 11 .. the tabular fins 12 and 12 — the time of the expansion working at the time of attaching .. the tabular fins 12 and 12 — it is lost that .. bends. As a result, since expansion working can be performed at sufficient expansion rate, the adhesion of the heat exchanger tube 11 and the tabular fin 12 can be secured, and heat exchanging performance improves.

[0023]

Incidentally, when change of air side heat transfer coefficient R-a_0 by change of the board thickness tf of the tabular fin 12 was investigated, as shown in drawing 6, in the range of board thickness tf=0.15mm-0.2mm of the tabular fin 12, it turned out by the same draft resistance that the maximum is shown. That is, in the same draft resistance, best performance can be obtained in the range of board thickness tf=0.15mm-0.2mm of the tabular fin 12. Board thickness tf of the tabular fin 12 = being referred to as 0.18 mm is desirable from improved efficiency.

[0024]

About the fin pitch Pf of the tabular fin 12, it turns out that it is desirable to set it as the range of fin pitch Pf=1.6mm-2.0mm. If it does in this way, the dynamic augment of the fan F for cooling can be stopped to the minimum. When referred to as fin pitch Pf<1.6mm, if [a draft resistance becomes large too much, and fan power will increase too much, and] fin pitch Pf>2.0mm, the number of the tabular fins 12 will become fewer too much, and heat exchange actions will become insufficient.

[0025]

Without increasing a pressure loss, when the heat exchanger concerning this embodiment is used as a heat exchanger for exhaust heat recovery, it can become possible to increase a solution circulating load, and exhaust heat recovery quantity can be made increased as a result.

[0026]
In the above-mentioned embodiment, as for the invention in this application, although the heat exchanger for exhaust heat recovery was explained, it is needless to say for it to be able to apply to the heat exchanger for exhaust air handling etc. in which air carries out heat exchange to the heat carrier from air cooled absorbers or a chiller used for an air-cooling absorption type refrigerator.
[0027]
[Effect of the Invention]
the tabular fins 12 and 12 of a large number which are fitted in by a crossed state to the periphery of the heat exchanger tube 11 and this heat exchanger tube 11 according to the 1st means of the invention in this application — in the heat exchanger which consists of .., Since the board thickness of each of said tabular fin 12 is set as the range of 0.15 mm - 0.20 mm and it was made for each tabular fin 12 to have sufficient intensity while setting the tube diameter of said heat exchanger tube 11 as the range of 18 mm - 23 mm, the heat exchanger tube 11 — the tabular fins 12 and 12 — the time of the expansion working at the time of attaching .. the tabular fins 12 and 12, since it will be lost that .. bends and expansion working can be performed at sufficient expansion rate, the heat exchanger tube 11 and the tabular fins 12 and 12 — the adhesion, ... can be secured and it is effective in heat exchanging performance improving.
[0028]
In the heat exchanger [as / in the 2nd means of the invention in this application] provided with the 1st means of the above, they are said tabular fins 12 and 12.. When the fin pitch Pf can also be set as the range of 1.6 mm - 2.0 mm and is constituted such, the increase in ventilation power can be suppressed to the minimum.
[0029]
In the heat exchanger [as / in the 3rd means of the invention in this application] provided with the 1st or 2nd means of the above, much louver shape cuts on said each tabular fin 12 — the pieces 16 and 16 of a lifting — cutting, when .. can also be formed and being constituted such — the pieces 16 and 16 of a lifting, while heat transfer performance improves by promotion of the boundary layer destruction by .., Fin intensity increases and they are the tabular fins 12 and 12 to the heat exchanger tube 11.. Fit-in workability also improves.
[Brief Description of the Drawings]
[Drawing 1]It is a lineblock diagram of the exhaust-heat-recovery regenerator which uses the heat exchanger concerning the embodiment of the invention in this application.
[Drawing 2]It is a perspective view of the heat exchanger (exhaust-heat-recovery heat exchanger) concerning the embodiment of the invention in this application.
[Drawing 3]It is an expansion crossing top view of the heat exchanger concerning the embodiment of the invention in this application.
[Drawing 4]It is an IV-IV expanded sectional view of drawing 3.
[Drawing 5]It is an important section expansion perspective view of the tabular fin in the heat exchanger concerning the embodiment of the invention in this application.
[Drawing 6]It is the characteristic figure which compared the performance of the tabular fin in the heat exchanger concerning the embodiment of the invention in this application.
[Description of Notations]
11 turns off the heat exchanger tube, a tabular fin and 16 cut 12, and, as for a tube diameter and tf, in a heat exchanger and phi, board thickness and Pf are [the piece of a lifting, and A] fin pitches.

[Translation done.]